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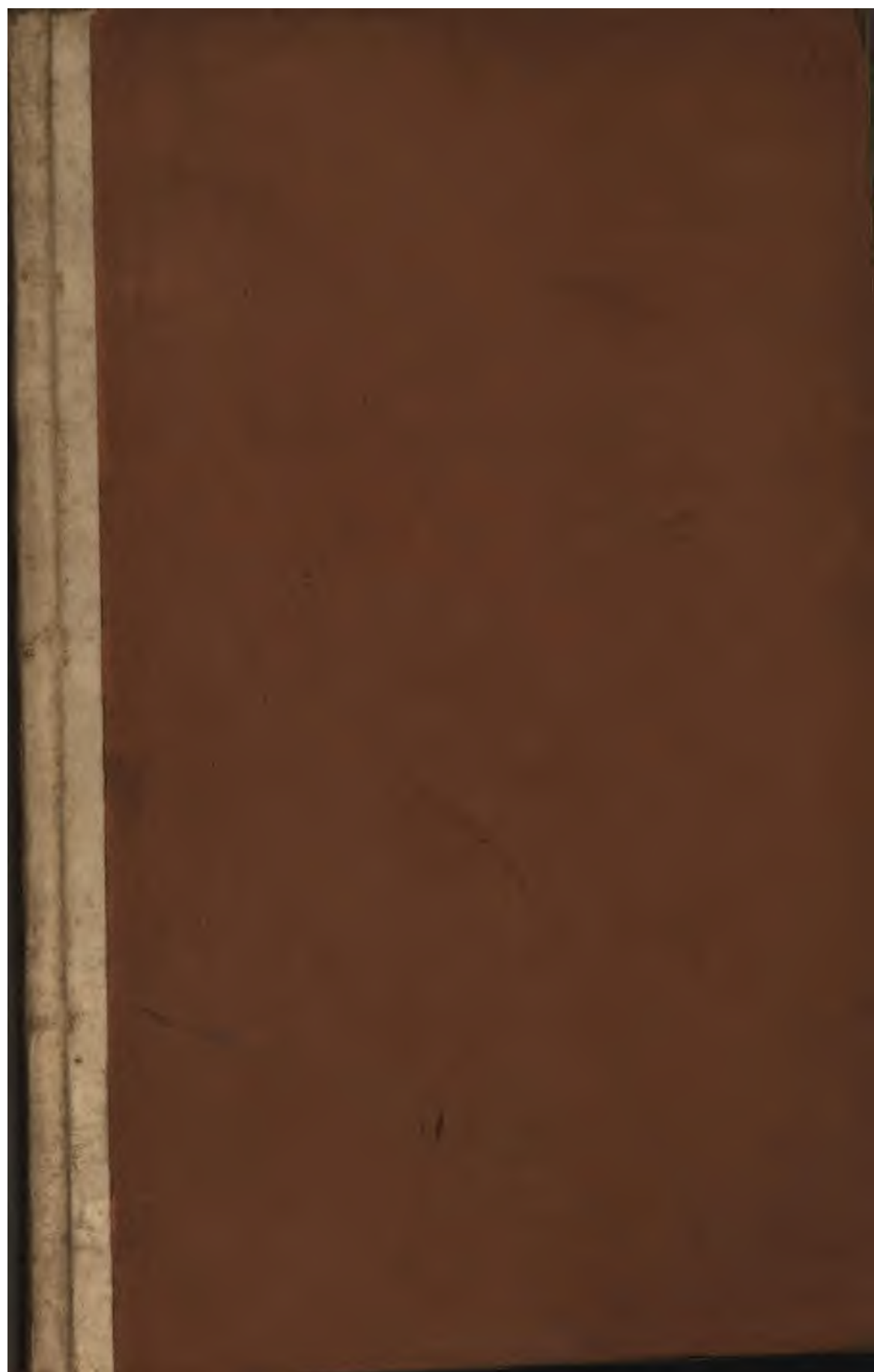
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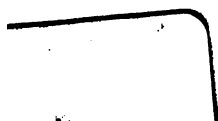
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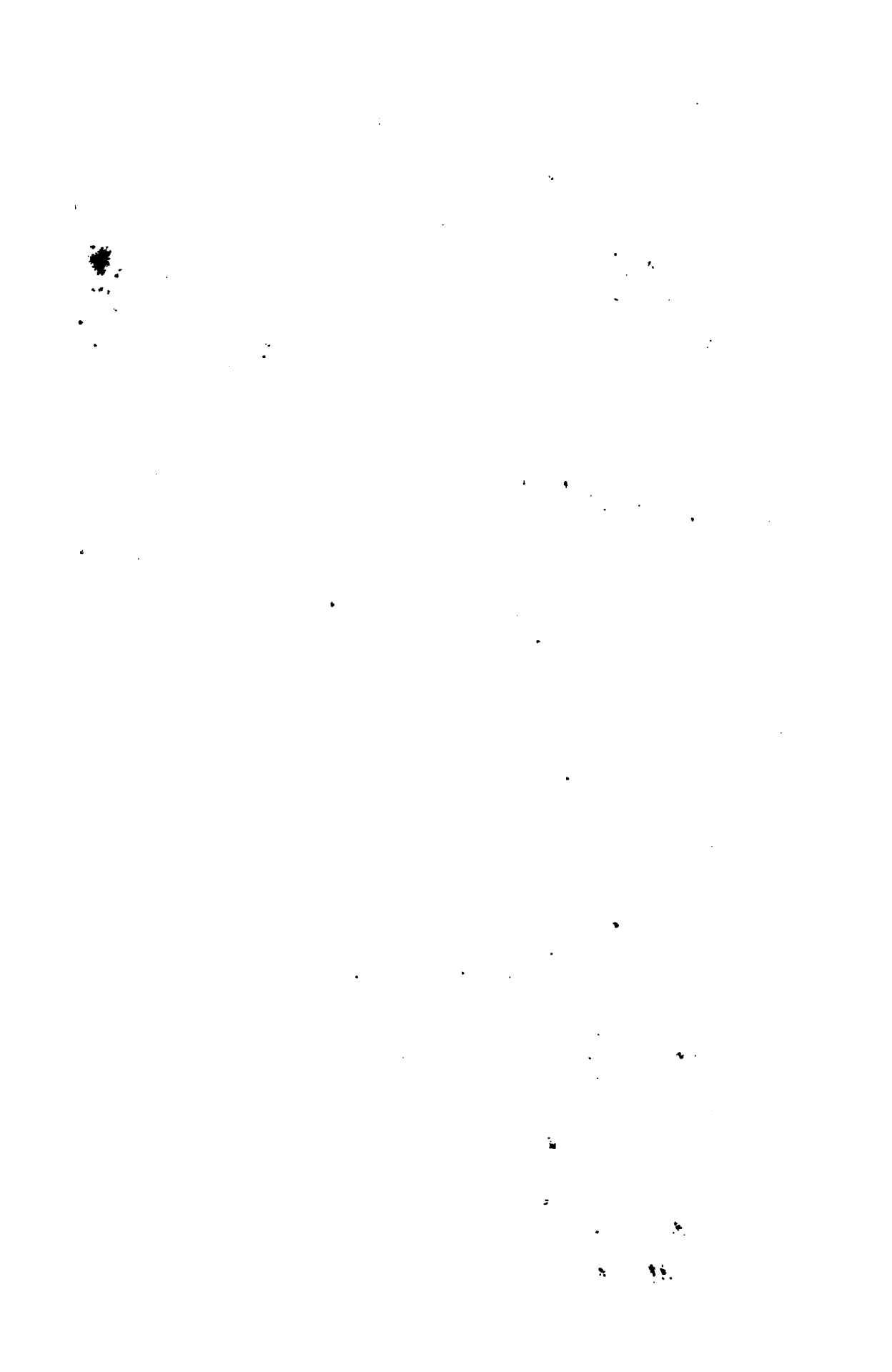




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Prevention better than Damage, Suffering, and Loss of Life.

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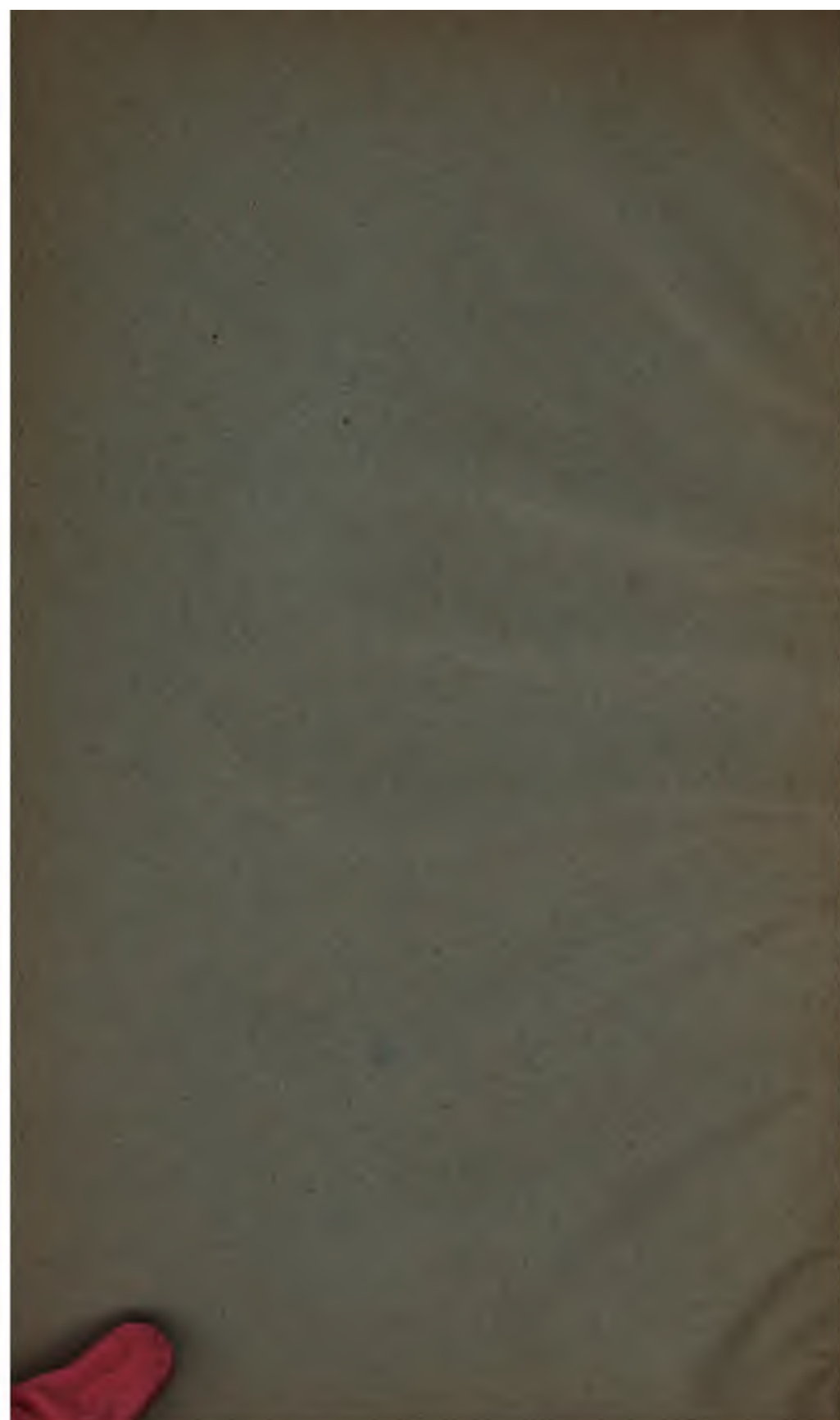
*A REVIEW*  
OF THE  
FACTS AND RECORDS  
IN CONNECTION WITH  
KITCHEN BOILER EXPLOSIONS  
AND  
HOT-WATER BOILER EXPLOSIONS.  
OF 1881,

*With some remarks upon their Prevention and the Remedies.*

By SAMUEL B. GOSLIN, F.M.S., &c.,  
Hydraulic Engineer.

LONDON:  
J. WARNER & SONS, CRESCENT FOUNDRY, CRIPPLEGATE, LONDON, E.C.,  
AND  
MCCORQUODALE & CO., LIMITED, CARDINGTON STREET,  
HAMSTEAD ROAD, N.W.

1881.



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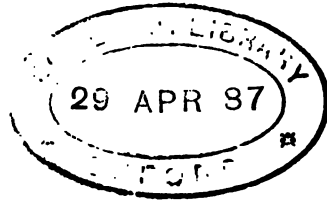
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## INTRODUCTION.



IN these days of loss of life and damage to limb and property,—in these days when the wrong persons are blamed for blunders of construction, and applications connected with social comforts, and sanitary arrangements; when many erroneous opinions are offered to the public in connection with warnings and remedies, and when, in the haste of the time of necessity, unsatisfactory and half-bred copies of well-tried and studied applications are advertised, and placed in the saleable channels, as the means suited and adapted to the desired end,—it is thought that a few words on this important subject will not be out of place from one who, for twelve years at least, has devoted special attention to the circumstances, wants, and remedies of the case.

S. B. G.





**V**HENEVER it is seen that any of the members of our family circles, are exposed to dangers in the ordinary surroundings, and callings of daily life; whenever it is possible for them to avoid the dangers, and protect them from the consequences of a sudden and sure disaster, then, and at that moment it becomes the duty of everyone, not only to make suggestions; but for those who are placed in the positions of responsibility and care, to seek for a remedy in view of prevention, and for those whose thoughts have been directed to the specific subject, and whose experience has enabled them to speak with the advantage of practice, to point out how such dangers are to be dealt with and safety secured.

The alarming accidents which have been recorded from time to time in the daily press and medical journals, especially within the last ten years, and notably during the recent severe weather, in connection with the explosions of kitchen and hot-water boilers (some of which are appended to this paper), are sufficient to arouse the fears of every head of a family or institution, who has that useful and convenient sanitary arrangement of hot-water supply for lavatory, bathing, and kitchen purposes, under his charge or control, and to devote some amount of attention to find a simple and suitable remedy against such a calamity.

To be living in constant danger of pain, loss of limb, property, or life, is now and has been the condition of many families and servants, especially cooks and kitchen helpers, for years past when a change of temperature has occurred sufficient to cause "a frost," or when, from other simple and natural causes in connection with the working of hot water in close boilers, every condition is ripe for explosion or scalding.

It is strange, but no more strange than true, that many are indifferent, and careless in the face or view of any mishap, and that the "cry of danger," be it ever so loud, will not awaken their sense of responsibility and exercise of precaution. Years roll on—the "very sharp" seasons and critical moments pass, the explosion at the neighbour's dwelling is half forgotten, and in indolence, or want of precaution, rather than in simplicity, the dangers which caused deep impressions in the past are glossed over, and the dangers are faced again, somewhat in fear, somewhat increased in possibility, but with procrastination, until the fatal moment arrives.

The responsibility in such cases is generally shifted from one to another, so that the weakest has to bear the burden. Wrong impressions are made by publication of the supposed facts, and often by the counsel given by the persons who are appealed to, as those who should be the safe-guides under such circumstances.

In these days, when every movement in Nature, and every application for the utilisation of Nature's stores and forces, <sup>are</sup> brought under the rules of science, anyone and everyone would conclude that disasters such as arise from kitchen or close boiler explosions would be prevented by some simple contrivance, and that every house might be in safety as clearly from these misadventures as from sewer gas, or disease.

It may be, therefore, well at this time briefly to enumerate the causes, and to suggest the remedies for universal adoption for the preservation of valuable life and property, with some few explanatory remarks.

In looking through the daily public journals and scientific periodicals, for a solution of the causes of the explosions of kitchen and hot-water boilers, one cannot help making a pause, at the apparent oversight of one of the very first principles or axioms as to force and resistance, inculcated into the youthful minds of schoolboys, "That nothing is stronger than its weakest part;" and at the suggestions which have been freely circulated to make weak parts or points in the system of pipes, or circulation, by the use of thin metal discs, soft metal plugs, and thin circulating cylinders in the kitchen, as flour-bags inflated, but with water instead of air, to go bang when an extra pressure is exerted in the boiler or circulation

pipes; when it must be the frequent case that if such weak places are made in the circulating system and all similar remedies, they must of necessity be sufficiently strong and tight, to resist the ordinary working pressure, and that is often more than the boiler, which has been in use for years (the part of the system which has had the most wear and tear, and by that wear has corrosion, and has become the weakest) is able to bear; and for which the simple and safe precaution or remedy must be, as it is in the case of steam boilers for engines, a periodical examination by a skilled person in the construction, thickness, conditions, and strengths of boilers, at least every twelve months, and, far preferable, every six months, which might be done for a stipulated fee or subscription.

The consensus of public opinion appears to be, that such calamities are only and solely occasioned by cold weather and freezing, generally from the circulating pipes becoming plugged with ice, preventing circulation; the expansion pipe—if there be such an appendage to the system—becoming stopped, and preventing the expansion of the water when heating or heated, or in some cases it is considered that by drawing off the hot water from the boiler and pipes below an ice-plug, steam is generated, and an explosion in either case is inevitable; but similar results must follow under like conditions without frost, if the circulating pipes are stopped by stop-cocks, choked with fur, or other similar checks or stoppages exist in the flow or expansion of the water.

Again, the general consensus of opinion appears to be that in nearly every case where pipes become frozen, it arises from the ill-judged and exposed position in which they are placed, or run against an external wall, in a corner, near to the external atmosphere, or between lath and plaster, where it is difficult to have access to or to protect them. For this there is a simple remedy, if Architects would only set the fashion, by making a provision for a water-pipe trunk to be carried up against an internal, and protected wall, and to provide that all cisterns should be easy of access; and for every one taking or purchasing a house, to make it a standing point that the water cisterns connected with hot-water supply, and close kitchen boilers, shall be in protected positions, not as they are placed in ordinary cases, where they are exposed, immediately under the slates of the roof. Then, if the all-important enquiry is made by

the public, the jerry builders and competition hot-water and gas runners, will find that they must work to please, if they do not from copying the architect's better methods, or with the view to safety.

It is strange that the assertion should have recently been made, in a leading article in a leading scientific journal, that the boilers which are fixed at the side or the back of kitchen ranges or fires for hot-water circulation or bath services, are constructed of cast-iron; it may be the case in Manchester, and in some of the Midland county towns, but in London, from whence thousands of such ranges and boilers are disposed of, it would be considered a "notable circumstance" if the boiler was not of welded wrought-iron, as it should be. When such boilers are made of cast-iron the dangers are multiplied, and the chances of an explosion, by the cracking of the metal, when the boiler may become empty, and the cold water supply rushes in suddenly, are easily understood—a result of no mere antiquated theory or erroneous ideas. All such boilers should be of good wrought-iron or copper, and thoroughly tested by hydraulic pressure to at least 70 lbs. on the square inch before use, and be provided with a testing plug and cap for the attachment of a test pump, to prove the soundness and strength from time to time.

Without going into the scientific niceties, of the causes of boiler explosions in connection with the heating of water or generation of steam, the child has seen the lid of the saucepan or kettle lifted by the expansion, and force which the heat has generated in the closed vessel; the youth has, perhaps, tried the experiment of boiling water in a tightly-corked bottle, to produce an explosion by the same means; and, setting aside the defects of workmanship in the erection of pipes and cisterns, the neglect of proper inspection, the usual custom in connection with this class of applications, is in nearly every instance to arrange the apparatus so that it is by a simple variation in the atmosphere, ready to act the part of the tightly-corked bottle, with ruinous and appalling results.

The only safe precaution or remedy for this existing state of affairs has been justly pointed out in the provision of a safety-valve upon, or in connection, and in close proximity, to the boiler; and in connection with this arrangement, although the dead-weight principle has been advocated, an examination will demonstrate the

fact that in one design it is very liable to set fast on its seat, become choked or furred up in the very small opening which is intended to relieve the boiler, and in all dead-weight valves there is the difficulty of nice adjustment, as well as the cumbersome weights to be suspended, either on a small spindle or lever, and the necessary large dimensions, to effect the object desired.

The valve and safety-taps for this particular purpose, which were thoroughly studied by W. Randall, Esq., C.E., of Belsize Park, Hampstead, some years since, after a kitchen boiler explosion at his own residence, have many advantages, as the capability of exact and fine adjustment to the exact vertical pressure which may be found in each house, compactness of form and arrangement, easily fixed and examined, and renewed seatings applied when needed in a few minutes, as well as being inexpensive in first cost ; indeed, as to safety-valves on close kitchen boilers, it has recently been said by the *Engineer* that "servants go with their lives in their hands during sharp frosts," and "the only plan," "except defects or leaks from bad work, or drawing the entire system empty every evening, to secure immunity from explosions, is to fit the boiler with a safety-valve."

There can be no doubt, but that the remedies are all to be found within easy reach of the community, and if every responsible person would only act in adopting these remedies, there need be no fear of danger or loss of life.

1. By having the boiler of good welded wrought-iron, properly tested before using.

2. By having a periodical inspection and report upon the condition of its strength and safety, and, if corroded, cleaned.

3. By having a proper pipe trunk carried up in a protected position for the pipes, and not against an external wall.

4. By having the cisterns placed in a position protected from frost and easy of access.

And in every case or any case, whether the preceding can be so arranged or carried out or not, by having a safety-valve which can be easily adjusted, easily seen, easily taken apart and fixed, sensitive to slight variations of pressure, and not easily choked up by soot or corrosion or rendered useless and inoperative.



There can be no doubt, but that the usual circulating hot-water system has many advantages over gas boilers, in being less costly in the majority of cases, where a kitchen fire is always going, and that if safety can be secured, it is a sanitary arrangement of the greatest value.

To effect the better protection of life, and limb, from the effects of boiler explosions, in connection with hot-water engineering, there must be for the future a more united action between the architects, surveyors, and hydraulic, sanitary, and hot-water engineers, in the arrangement of the pipes, cisterns, and other apparatus in every house, and a means provided for the employment of duly qualified inspectors, as well as more skill and knowledge exercised in the execution of the details of the work.

In how many instances is it the case, that men are employed to erect, examine, report, and repair such arrangements, with no more sense, knowledge, or skill, than the deluded man who paid the penalty of acting in ignorance at Blackheath this year?

In how many cases is the fact that the Range dealers and Range makers, have neither the necessary knowledge themselves of the best arrangements of hot-water supply, so as to impart the information to their purchasers; or in how many cases, even in these days, is it found that no printed directions can be obtained by country tradesmen, to guide them in the erection of the useful and comfortable arrangement of domestic hot-water supply.\*

The difficulty is often proposed, in connection with the application of safety-valves to kitchen boilers, that the space is insufficient to admit them; this, however, is only imaginary if the Randall's Valve is adopted, as it can be attached to a boiler direct, or to a short bend or pipe brought through the covings of a close fire kitchener, and to the top of the circulating cistern, as is shown by the following illustrations:—In each case, as near to the boiler or cistern as possible, if it is impossible to be actually upon the boiler or cistern itself, the adjustment is simple and easy, for when the valve is fixed and the water is admitted into the boiler, cistern, and pipes, the cap can be easily screwed down until the vertical

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\* Messrs. Steven Bros., of Upper Thames Street, and McDowall, Steven, & Co., of Glasgow, write to say that they are preparing a full description of the best and proper methods of fixing their kitchen ranges and hot-water boilers, which, if carried out, will prevent explosions.

water pressure, from the supply cisterns is overcome or balanced, and the water just ceases to run through the small holes of the cylinder of the valve, then a turn or half-a-turn more of the top adjusting cap, will be sufficient to allow for the ordinary expansion of the water or steam in the boiler, and the lock-nut screwed up tight to prevent the cap shifting, will secure, as it has in numerous instances, for years, an inexpensive, simple, and perfect means of safety with a sound boiler against hot-water and kitchen boiler explosions, even when the pipes become choked or stopped by ice or other obstructions.

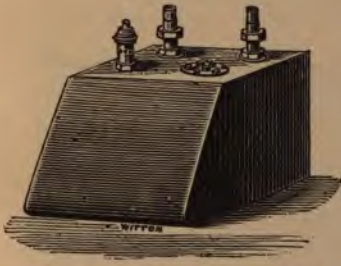


Illustration showing Randall's Safety-Valve, as applied direct to a Close Kitchen Range, Wrought Iron Back Boiler.



Illustration showing Randall's Safety-Valve, as applied direct to a Wrought Iron Welded Saddle Boiler.

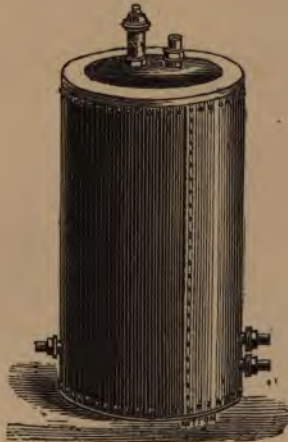


Illustration showing Randall's Safety-Valve, as applied to a Circulating Cistern placed in a kitchen.



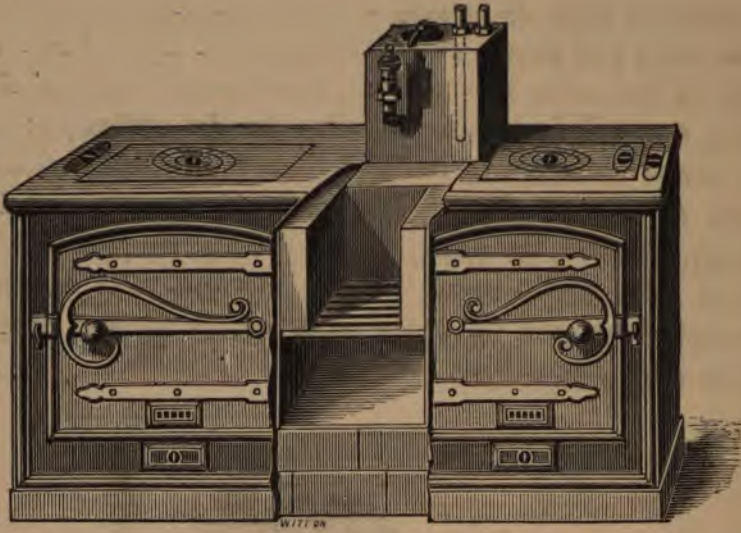


Illustration showing Randall's Valve, as applied to a Close Fire Kitchen Range L Shape Wrought Iron Welded Back Boiler, in Section.



Illustration showing Randall's Valve, as applied to a Close Fire Kitchen Range, Wrought Iron Back Boiler, mounted on short pipe to prevent damage by cooking utensils.

A few of the recorded cases of kitchen and hot-water boiler explosions during the severe frost, January, 1881, and comments thereon from public sources :—

*Daily Telegraph, January 17th, 1881.*

CARLISLE.—To-day a boiler exploded in a house in Spencer Street, occupied by Major Gillies, 55th Regiment. The kitchen-windows and door were blown out and other damage done. A private soldier named Young, belonging to the 55th, a servant of Major Gillies, was killed on the spot.

OXFORD.—Shortly after ten o'clock on Saturday morning, a kitchen boiler burst at the Vicarage, St. Frideswides, here, the residence of the Rev. G. L. Kempe, and killed the cook. It appears that the pipe which carried off the steam was frozen, and this caused the explosion.

*Daily Telegraph, January 18th, 1881.*

GLASGOW.—A fire occurred to-day in the Port Dundas Distillery of Harvey & Co. The damage amounts to several thousands of pounds.—This morning a boiler explosion took place on the premises of Messrs. John Orr Ewing & Co., calico printers, West George Street. Two windows were blown out, a stone staircase and iron-railings shattered, and five plate-glass windows in some neighbouring offices destroyed.

*Daily Chronicle, January 18th, 1881.*

BOILER EXPLOSIONS.—Another boiler explosion occurred in Maidstone yesterday morning, within a few feet of the spot where, last month, a traction engine boiler exploded. It will be remembered that the recent disaster caused considerable damage to a workshop of Mr. J. Clements, builder, and it seems that on the ground floor of the building a saddle boiler has been employed for the purpose of supplying a warming apparatus. About 8 o'clock two lads, named Elphick and Parker, were standing near the boiler when it exploded, and both the boys were scalded, Elphick somewhat seriously. He was at once taken to the West Kent General Hospital, and there speedily attended to, while Parker was removed to his home at Coxheath. The force of the explosion blew out one of the walls of the building, which was otherwise damaged.—Yesterday morning a boiler explosion took place on the premises of Messrs. John Orr Ewing & Co., calico printers, West George Street, Glasgow. Two windows were blown out, and a stone staircase and iron-railings were shattered. Five plate-glass windows of some neighbouring offices were also blown out. The clerks had not arrived, otherwise life probably would have been lost.—A kitchen boiler burst at Auchencairne, Dumfriesshire, yesterday, killing a servant on the spot and injuring Miss Borland, a farmer's daughter, so seriously that she is not expected to recover. Her mother is also severely injured.

NEWPORT (MON.).—Frederick James, a child of about three years, died yesterday from the effects of the explosion of the kitchen range boiler in the house of Mr. A. H. James, marble mason, Dock Street.

Shortly before noon, yesterday, a kitchen boiler exploded with a loud report at 3, Weatherby Terrace, Earl's Court Road, Kensington, the premises of W. Rudkin, china and glass dealer. The fire-grate in the basement was completely blown out, and the shop and upper part of the house suffered from heat, smoke, water, and breakage.

*Daily Telegraph, January 24th, 1881.*

KITCHEN BOILER EXPLOSIONS.—At the Tiverton Infirmary, on Saturday, the boiler exploded and killed a boy, while a nurse was severely injured.—On the same day, at Mr. Grant's, St. James's Street, the boiler exploded, throwing down Mrs. Murrell, the house-keeper, and her daughter. They were both taken to Charing Cross Hospital in an unconscious condition, but are now progressing favourably. There were three deaths last week resulting from carelessness in the use of kitchen boilers.

*Daily Telegraph, January 25th, 1881.*

KITCHEN BOILER EXPLOSION.—The residence of Mr. Frederick Willis, barrister, Woodville Lodge, Kidbrook, near Blackheath, was the scene of a fatal occurrence on Saturday night. The supply pipe of the kitchen-range being leaky, the fire had not been lighted for some days as a precaution, and on Saturday two workmen named Henry Pascoe and John William Spicer, were sent to do the requisite repairs. They at once lit the fire, although warned by Mr. Willis that there might be danger of an explosion, Spicer remarking that he knew all about it, as he had put in the boiler when the house was built. Pascoe had just left the room while Spicer remained at the range, when a loud explosion took place, inflicting such injuries that the unfortunate man died the same night at the Cottage Hospital. He was fifty-three years of age.

*Daily News, January 17th, 1881.*

PLYMOUTH.—A fatal boiler explosion occurred at Wheal Eliza Mine, St. Austell, on Saturday. The boiler was the centre one of five, connected together for working the pumping engine. The engine was stopped for repairs, and the steam of several boilers was reduced and the fires banked. The safety-valves were all set at forty pounds pressure, but while the work was proceeding the centre boiler was noticed to be blowing off steam. John Peters, the engineer, was in the act of further damping the fire when the explosion took place, completely wrecking the boiler and scalding Peters so severely that he died yesterday.

*Daily News, January 18th, 1881.*

DUMFRIES.—A kitchen boiler burst at Auchencairne, Dumfriesshire, yesterday, killing a servant on the spot and injuring Miss Borland, the farmer's daughter, so seriously that she is not expected to recover. Her mother is also severely injured.

LOUGHBOROUGH.—Two domestic servants, named respectively Elizabeth Kirk, aged 17, and Elizabeth Draycott, aged 20, are now lying in the infirmary in a precarious state, suffering from injuries sustained by a boiler explosion. It seems that to the kitchen range of their employer is attached a self-filling boiler, supplied from a cistern regulated by a ball tap. Whether the tap had become frozen or the water was inadvertently turned off is not known, but when the boiler plates became heated they cracked, a loud report was heard, and the *debris* was scattered in all directions. Both the domestics sustained a compound fracture of the leg, and have been extensively burned. The kitchen chimney was destroyed, the ceiling cracked, and the walls forced out in a manner that will necessitate re-building.

To-day a serious boiler explosion took place in the house of Mr. Canning, Cliftonville Avenue, Belfast. During the night a pipe in connection with the kitchen boiler got frozen, thereby stopping the supply of water. The boiler having got thoroughly heated, burst with a loud crash. Mrs. Canning and the servant girl were both injured; the wall between Mr. Canning's house and the adjoining house was blown down by the explosion, and another wall in Mr. Canning's residence became damaged in a similar manner. The furniture in both houses was greatly injured by the explosion.

*Daily Telegraph, January 21st, 1881.*

#### KITCHEN BOILER EXPLOSIONS.

In a single copy of a daily paper this week we noticed no less than six cases of boiler explosions in private houses, resulting in three deaths and two persons seriously injured, as well as great damage to property. In each case frozen pipes are supposed to have been the cause of the accident, and in all probability this supposition is correct. Under ordinary circumstances the water has free access to the boiler, and when heated passes from it to a hot-water tank in some other part of the premises for the supply of a bath and lavatory. But if anything interferes with the free admission of water an explosion might result from the overheating of the boiler, and the generation of large quantities of steam in consequence. The sudden admission of water to an over-heated boiler would have a similar effect. But whatever may be the precise cause, there can be no doubt that these accidents point to a serious defect in the present construction of kitchen ranges and hot-water apparatus, which calls for the attention of sanitary engineers. In the meantime we should recommend our readers to enjoin attention to the state of the kitchen boiler, and to have water drawn off whenever it is heard to be boiling.—*British Medical Journal.*

A boiler explosion of a serious character occurred last evening at the National School connected with the parish of St. Nicholas, Newbury. The school-rooms are warmed by a hot-water apparatus, and, owing to the severity of the weather, the boiler burst, upheaving the flooring, blowing out the door, and doing other damage. The slates of the school children were broken into fragments and the ink was scattered over the ceiling.

*Daily Telegraph, January 25th, 1881.*

BURY.—Two more kitchen boiler explosions have occurred here, and in both cases the houses were badly wrecked. In one instance a gentleman named Clark was badly injured, and for a time was thought to be blinded.

*Daily Chronicle, January 24th, 1881.*

#### KITCHEN BOILER EXPLOSIONS.

To the Editor of the DAILY CHRONICLE.

SIR,—The numerous kitchen boiler explosions during the past few days are doubtless all due to over-pressure of steam, consequent on the various connecting pipes getting frozen, thus allowing steam to be generated without any means of escape, and the best and simplest remedy is a small dead-weight safety-valve (attached to the boiler), and such as is usually fitted to steam boilers, and whether the exhaust or return or circulating pipes become frozen, there would not be the slightest danger so long as the valve was kept in order. The theory that boilers explode from a sudden rush of cold water on to the hot plates has long since been proved by actual experiment to be erroneous.

I am, Sir, your obedient servant,

26, Camden Road, N W., Jan. 24.

J. H. D. ALLEN.

#### KITCHEN BOILER EXPLOSIONS.

To the Editor of PUBLIC OPINION.

SIR,—If I understand rightly the steam generated by the sudden rush of water into a heated empty boiler also causes an explosion. Would Mr. Fletcher be kind enough to say if the safety-valve recommended by The Manchester Steam Users' Association requires keeping in order?

I am, Sir, your obedient servant,

Beach Cliff, Westgate-on-Sea, Jan. 30, 1881.

CHARLES F. MORRIS.

*Daily Telegraph, January 26th, 1881.*

Deaths from the explosion of boilers in private houses have been so lamentably frequent during the present hard frost that they form an important feature of the public calamity. More serious, however, than the actual number of such accidents that have already occurred is the danger which every house with a boiler in it runs from day to day. Some thirty lives have been lost from this cause, and the reckoning is dreadful enough to contemplate ; but many thousands are living on with the very same peril of explosion present in their kitchens, and at any hour, by the wilfulness or stupidity or carelessness of a servant, or by the neglect of the plumber called in to see that all is going well, the boiler may burst, wrecking the kitchen and killing those in it, bringing down the floor above, and spreading ruin in an instant throughout the lower stories of the house. It is difficult for householders and families to understand this. They are so accustomed to their boiler, the familiar feature of the kitchen range, that they can as little connect death and havoc with it as with the cat upon the hearth. If the cat were suddenly to develop into a man-eating tiger, to rush with a roar upon the kitchen-maid and fell her to the ground with a single blow of its paw, she would be greatly surprised. But even such behaviour as this would not astonish her more than the bursting of the boiler. In a general way she knows that boilers burst occasionally ; but then these are always somebody else's boilers and not her own, and it does not seem to enter within her vision of the possible that the machine of which she herself has charge should suddenly some day go off with a bang, and blow her into atoms. So she listens blandly to all her master's explanations and exhortations, and promises obedience ; but, the moment his back is turned, she proceeds to draw "just a little" water out of the familiar tap, to save herself the trouble of boiling a kettle, and, when going to bed, rakes out the kitchen fire, and lays it ready for the morning, so that her cold fingers next day may have as little to do as possible. In vain has her master tried to explain to her carefully that within the week a kitchen-maid in St. John's Wood has been killed by a boiler exploding which had been unduly emptied, or a cook at the East End blown to pieces when re-lighting the fire, which has been allowed to go out too early overnight. She understood his warnings as referring to some very vague possibilities that might have happened in some remote period of time ; at all events, as to something that could never occur to herself. So she goes on her way complacent and self-satisfied, until one day the kitchen requires a new boiler and a new cook.

Though under such circumstances blame, no doubt, is to be attributed to the servants, much, nevertheless, depends upon the master and the mistress of the house. In the first place, the kitchen boiler can always be rendered harmless by emptying it, and by keeping it empty until warm weather sets in. Of course, in that case, the kitchen fire must be allowed to go out, and must not be re-lit, or the empty reservoir will split with the heat, and, though not dangerous to life, will be costly to the purse. It is not however, in every household that the extinction of the fire can be borne, for, however amusing it may seem in theory to live pic-nic fashion all over the house for a few weeks, in practice the absence of the kitchen fire proves a very severe trial all round, both in point of comfort and temper. When, however, life and limb are concerned, even the inconveniences of a cold hearth are not considered by some to be too great a price for safety, and so, in spite of the unconcealed contempt of the cook, the disgust of the housemaid, and the consternation of the cat, the kitchen fire is allowed to die out, the boiler drained empty, and desolation formally takes possession where comfort used to sit enthroned. At this price safety may be absolutely assured ; but human nature is so constituted that, even for safety, such a procedure as the extinction of the kitchen fire

will not generally approve itself. Next, in point of security, comes the device of keeping the cistern that supplies the boiler always filled, and taking care that no water is ever drawn from the boiler. By this means the heat of the boiler is kept as nearly as possible at its maximum, and the greatest resisting power is given to the steam. But even here there is a flaw for frost to work mischief in, for, unless care is taken that the steam escape-pipe, wherever it may be, is thoroughly free, that all-important orifice may suddenly become caked with ice, and explosion naturally results. Or, again, it may happen that in the night hours, when the kitchen fire has gone out and the frost is at its hardest, the pipe somewhere or another will get frozen, the steam will gradually collect into ice, and the result to the boiler will be the same—immediate explosion. To this end builders often carefully work, for they will run the pipes, quite unconsciously, as near the outer air as possible, and subject them, therefore, to all the freezing influences that they can, instead of carrying them warmly and safely up the corners of the wall inside the house, where they would not only escape the perilous cold, but would be always under easy observation. It may be, too, that the waste-pipe from the bath-room upstairs debouches upon the leads, and to take it out a hole has to be made in the outer wall. Alongside the waste-pipe runs the other, in which the hot water circulates between the boiler and the bath, and this also passes over the hole which has been made; but it does not occur to the builder's men that a basketful of cement would be well spent in stopping up this hole, and so prevent the freezing blast from playing full upon the hot-water pipes, upon whose heat the safety of the house depends. They leave the hole open, and, when the freezing blast does blow, the heat of the pipes and the cold of the air fight it out all through the long night by themselves, while the household, unconscious of the explosive force struggling for freedom, sleeps on. Next morning the plumber, called in to explain the mystery of cold water in the bath, announces to the astonished family that they have escaped disaster by a miracle. "The hot pipe, you see, did not manage to get quite froze through. Perhaps you weren't using so much hot water over night as usual; anyhow, the boiler's not busted, thanks to luck."

On such accidents as these—the successful defence of a hot-water pipe against the siege of a freezing wind, a bucket or two of hot water more or less drawn from the boiler over night, an hour or two less of the kitchen fire on a certain day, an intelligent bather suspecting the chill on the water—does the safety of life and limb depend in this frosty weather. It is well, therefore, to have warnings and advice of experienced men made as public as possible. The ordinary household boiler, says one of these, situated in the kitchen, and supplying water to a bath-room in the upper part of the house, is very much more dangerous than any locomotive or steam launch that was ever yet constructed. It is set up by builders who know nothing of dynamics, is carefully tucked up out of sight, so that it can never be tested or examined, and finally it seldom has any safety valve. The only wonder, therefore, is that these boilers do not explode more frequently than they do. They should be of copper, instead of, as is usual, iron, for copper when exploding only tears and splits, while iron bursts with terrific force. In frosty weather the pipes above get choked, and the steam is unable to force the hot water through them, so it collects until the pressure becomes greater than the boiler can bear, and the boiler bursts. This is exactly what has happened in a score of houses in London already. One incident of these catastrophes, however, deserves special notice, for it is unfortunately the case that most men and women, rather than trust to their own intelligent judgments, place themselves in the hands of plumbers' men, who work simply by the rule of thumb, and who, because they have done one thing in one house, do exactly the same in the next, though the circumstances of the cases may be scientifically quite different. Such a



workman as this came to a miserable end at a house in Blackheath. He was called in to see a boiler which had been standing empty for some days, and proceeded at once to light a fire. The master of the house warned the man of the danger of lighting the fire ; but the unhappy plumber only replied that he "knew all about it, as he had put in the boiler when the house was built." It did not matter to him that when he put in the boiler and lighted the fire the last time it was midsummer, and not an unprecedented frost. He only remembered that he had himself put the boiler in, and that to test it he had lit the kitchen fire. So he did exactly the same again. He filled the cast-iron bomb-shell with water and set it boiling, the steam was generated and tried to escape. But upstairs the frost had caught it. Both pipes were plugged up hard with ice, and the steam gradually gathered in terrible strength behind the grate ; and then, all of a sudden, while the wretched plumber was actually standing before the fatal fire, exploded with awful force, wounding him so severely that he died almost immediately. Householders, therefore, should remember that the advice of working-men, let them be never so familiar with pipes, is no guarantee of safety, and that they must in some measure rely also upon their own common sense. If they wish to be absolutely safe they must empty their boilers ; but they can still be as safe as ordinary care can make human life under exceptional circumstances, if they will see that the boiler is kept regularly filled. If the pipes of the upper cistern are frozen so that no water reaches it from the main, they must see it kept partially filled by hand, and if the handle of the kitchen boiler can be taken off so much the better. Temptation is thus removed from lazy or careless servants, and one more chance of safety is secured. Yet, after all, the great lesson conveyed by the epidemic of explosions is that valuable one recently taught by the outbreak of fever in certain London localities—more caution and self-reliance among householders. A glimmering of the great truth that they must see to the state of their drains before they take a house has begun to steal gradually over the public ; but they have now to remember also that they ought to acquaint themselves with the position and conditions of the kitchen boiler and its pipes. A drain plan will, before long, we hope, be a regular accompaniment of the lease engagement, and some day, perhaps, we may expect also to see landlords compelled to place copper boilers where there are now iron ones, and to give them safety-valves.

*Plumber, February 1st, 1881.*

So numerous have been the fatalities arising out of the explosion of kitchen boilers and hot-water pipes during the late frost that it has been almost impossible to take up a newspaper without seeing some fresh list of casualties. Doubtless many of these are the result of ignorance or carelessness ; but every thinking man must allow that a system which admits of so many and so serious accidents with loss of life must be grievously defective, and that some better arrangement than at present exists is absolutely necessary in the construction of kitchen ranges and hot-water apparatus. In another part of the paper we call attention to an invention manufactured and supplied by Messrs. Warner & Sons which is specially designed to obviate the dangers arising from frozen pipes and close boilers which should meet with the hearty support of all sanitary engineers and others whose business it is to superintend the construction of this, at present, dangerous part of the household economy. That the present system is altogether wrong in this respect is painfully manifest, and any invention or appliance intended to insure greater safety merits at least a fair and patient trial.

*Builder, February 5th, 1881.*

#### BURSTING OF BOILERS.

SIR,—It is a wonder we have not more kitchen boilers burst through the frozen pipes than we have, owing to the new and defective system of fixing the circulation cistern and pipes in the kitchen, and then raising a single pipe which does not circulate as high or higher than the cold water supply-tank,—sometimes going through the roof without any protection ; the pipe soon gets frozen, thence a burst boiler.

The old plan of fixing the circulating cistern as high as the cold water at the roofing leaves a space at the top for expansion, which can neither freeze nor burst.

JNO. ELDRIDGE, C.E.

#### THE FROST AND BOILER EXPLOSIONS.

SIR,—A great deal has lately been written on this subject in the daily papers ; and having read Mr. P. J. Davies's letter on the so-called "Yankee" system of hot-water tanks in your last issue, and this class of work having come greatly under my notice during the last few weeks, I must say from experience that I have found this (the cylinder system) to be the best. The hot-water cylinder is placed in the kitchen, with flow and return pipes between it and the boiler, where, under ordinary circumstances, it should be impossible for them to freeze. The structure, however, is defective if there is a draw-off from the flow-pipe between the boiler and the cylinder. The object of this system being to keep the boiler and cylinder always full of water,—all draw-offs being taken from the expansion pipe, and in the event of this being frozen, it is, of course, *impossible to empty the boiler or cylinder*. To render the system absolutely safe the cylinder should be constructed of copper, as, in the event of its bursting, it will not scatter in fragments, dealing death and destruction around, but will simply burst after the fashion of a paper-bag. A safety-valve should always be placed either upon the cylinder or the boiler, but preferably on the cylinder, it being the weakest part of the system. It will be noticed that it is of vital importance to protect the flow, return, and expansion pipes from the *possibility* of freezing to insure proper working ; although, as a rule, this would only be necessary with expansion pipe, which might possibly be more exposed than the others. If the cylinder should be of iron, a good plan is to make the manholes tight with a piece of light sheet lead, which would give way to any dangerous pressure. I recommend the spring safety-valve, made by Messrs. Warner, which I have found thoroughly reliable. With the ordinary hot-water tank system, having a considerable length of flow and return pipe between the boiler and cistern, which is usually placed at the top of the house, there is much greater danger of the pipes becoming frozen, and the draw-offs are generally taken from the flow-pipe and often direct from the boiler, which must be condemned as a very dangerous practice, as the water being withdrawn, a space is left in the boiler to generate steam, which naturally results in an explosion, unless relieved by a safety-valve. The cylinder system has been in use in this country for many years, and was, no doubt, originally exported to America by some of our practical countrymen, the Yankees being, as usual, sharp enough to pick up a good idea, which they now carry out to perfection in every detail. I must say, in conclusion, that I thoroughly endorse Mr. P. J. Davies's remarks on *outside* soil-pipes, as my experience of this system coincides exactly with his.

JOHN SMEATON.

*City Press, February 5th, 1881.*

Writing with reference to boiler explosions, of which we have had some calamitous instances of late, Mr. F. Todd, architect, of 34, Essex Street, Strand, says :—" Hot-water

engineers—by such I mean those who thoroughly understand their work—usually adopt the precaution of inserting a safety-valve (which works automatically), fixing the same either at the top or at the side of the boiler, which on any extra pressure of the water taking place immediately opens and allows the imprisoned and expanded water to escape. I have been often surprised that such precautionary means are not generally adopted, the cost being very small, viz., from 8s. to 25s., a trifling sum for such an efficient insurance against loss of life and property. There are, I believe, one or two sorts of these valves used, but those which I consider efficient are the ‘Randall’s Patent.’ One cause of many accidents is the unskilful hands in which this work is often placed. The work is not generally ‘plumbers’ work’; only *bonâ fide* scientific hot-water engineers should be entrusted with such important details, which if incompetently executed may work ruin and disaster in many a home. I have no hesitation in saying that if only due precaution and skill were exercised in this ordinary but essential work, and a little judgment exercised in the position of the attendant pipes, very little fear need be apprehended, and that we should hear of but few explosions caused by the bursting of kitchen boilers.”

KITCHEN BOILER EXPLOSIONS.—The usual list of killed and wounded from this cause has already far exceeded its average annual proportions. Why such a cumbrous and costly mode of heating baths is persisted in is difficult to tell; but it is probable that until the plumber is made liable to be brought up for manslaughter there will be no change. The average Briton is far too conservative to give up an old system for a better. There is not the slightest reason why a kitchen or bath boiler should ever explode if properly fixed by a plumber who has the smallest amount of common sense. There are two simple ways by which an explosion can be totally prevented—one, by fixing a dead-weight safety-valve, which should be, for convenience, fixed when the apparatus is put up first. The other is to cut a hole in the hot-water return-pipe a little distance above the boiler, this hole being from half-an-inch to an inch in diameter; and to solder over this a piece of sheet lead about 1-32d of an inch thick, just sufficient to safely stand the general water pressure—making, in fact, a weak place in the system of the pipes which will be the first to give way. This hole must be cut in such a position that the pipe is certain to be warmed from the fire, and as near as possible to the boiler. It must also be where, in case of the sheet-lead being blown out, the water will not be thrown into the room, but into the fire so as to extinguish it. Any plumber should do this for a shilling or two; and, although it is liable to make a mess, it only does this when an explosion would occur in its absence. It is also easy to put an escape pipe through which the water could be let away to the outside of the building in case of accident. This thin lead safety disc might be made so as to fix in a brass socket and be easily re-placed if an accident did occur. The whole system of circulating boilers as at present fixed is radically wrong, as, with few exceptions, the hot water is rarely to be got when wanted in any quantity, and the cost of fuel expended is utterly out of proportion to the useful result obtained.—*British Medical Journal*.

*Plumber, February 1st, 1881.*

RANDALL’S PATENT BOILER SAFETY-VALVES AND TAPS. (J. Warner & Sons, sole proprietors and manufacturers, The Crescent Foundry, Cripplegate, London, E.C.)—We have much pleasure at this season in calling attention to this appliance, which should be classed among the most useful of modern inventions. The application of the patent is shown by the illustration, and the valve is put forward by the manufacturers as an unfailing preventive of kitchen boiler explosions. In introducing these improvements, Messrs. Warner & Sons state that the tap should be fixed to the boiler itself, or

to a pipe in connection with and as near to it as may be convenient, as a hot water draw-off cock for domestic purposes. The valve would thus be opened many times daily, and therefore could not stick fast, as other safety-valves often do, through being rarely brought into use. This tendency to stick or "set"—which is the great defect of the ordinary "ground-in" safety-valve—is additionally guarded against in the Patent Tap by the face of the valve being of a specially prepared vulcanite, which cannot corrode and will stand the action of hot water for a considerable time without deterioration. When the circulating pipes become stopped by frost or any other cause, and the water and steam in the boiler attain a pressure greater than the weight of the water in the circulating pipes, the valve opens and the heated water escapes into the sink or other receptacle placed beneath it; the draw-off tap thus forming, at the same time, a complete self-acting safety-valve. Where a draw-tap is not desired, as is the case in connection with some close range boilers connected with baths, or as saddle boilers connected with heating apparatus, a valve is constructed to be placed on the top of the boiler direct. The spiral brass spring (which cannot waste by rust or heat), when screwed down to the utmost, balances the pressure exerted on the boiler by the water in the circulating pipes in houses 60 to 70 feet high. For less heights, the workman in fixing the tap has merely to unscrew the cap until the water issues from the side aperture, and to screw it down again until it ceases to run (but not further), and then to tighten up the small set screw. At a time when so many fatal accidents are being recorded from the bursting of kitchen boilers, the invention under notice comes "as a boon and a blessing to men," and we are not surprised to hear that Messrs. Warner & Sons have received a very large number of orders for this valuable appliance.

## FROST AND WATER-PIPES.

To the Editor of THE IRONMONGER.

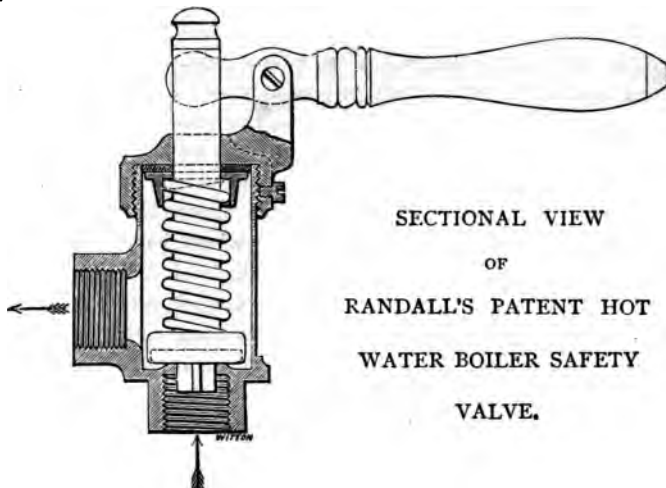
SIR,—Many of your editorials and many of the discussions which are to be found from time to time in your valued journal, have been for years past (as they are at the present) interesting to me, as they come fresh and fresh and week by week. I have been interested particularly in the question of freezing and thawing, as you are probably aware, for a considerable period, and have had the opportunity of seeing many examples of the working of Nature's silent forces. I venture to think that a few words from my pen will not, perhaps, be out of place, in the matter of "pipes," under the conditions set forth and queried of late. You will perhaps pardon me if I intimate to your contributors and subscribers that in a short time I shall have the honour and pleasure to submit to their consideration some statistics on pipes and kindred matters, which may be found very useful. No one, perhaps, will be found to be sceptical on the point of the expansion of water in the process of freezing who has had the opportunity of seeing a variety of pipes, pumps, and bends of metal or earthenware which have been exposed to the influences of extreme cold. The experiments made by Dr. Hope some years since placed the question of the expansion of water in the cooling process when the temperature was falling below 39° beyond doubt, and as it has been computed that the expansive force of frost or ice is equal to that of 1,000 atmospheres in many cases, it cannot be a matter of surprise that the ordinary  $\frac{1}{2}$  or  $\frac{3}{4}$  inch lead pipes will burst where frozen, as they are only calculated to stand a bursting pressure of 1,645 lbs. and 1,231 lbs. respectively, or that screwed wrought-iron pipes are likely to burst when the average testing pressure is 50 lbs. on the square inch. The cause of lead pipes bursting less freely in frost by ice is that the metal more easily distends than iron. There can be no doubt in the mind of any careful investigator of science that, under certain thawing

conditions, pipes are not only liable to become broken by the unequal expansion and contraction of the metal, especially in the case of those made of cast iron, but when a simple-minded person proceeds to suddenly thaw a frozen pipe in which there is a considerable length of frozen water or ice in a solid condition, then the part suddenly attacked with heat has a serious disturbance of condition, and is subjected to a pressure which it cannot bear. The whole length which is frozen up is, in many cases, as solid as it is possible to conceive. The influence of the boiling water or heat does not extend the whole distance of the solidified part. The part subjected directly and chiefly to the heat is thawed, and not only is thawed, but warmed; indeed, it is heated, and, as heat causes expansion as well as cold when applied to water, and especially so when the temperature (as I have found by actual and repeated experiments) is up to and above  $100^{\circ}$ , the two ice-plugs, in such cases, will not move from the outer positions of the portion of water which has been thawed or nearly boiled and expanded. Something must go. The weakest portion of nature's provision must make way for the stronger. The metal gives, and the simple-minded operator is saturated. The hot or boiling water, by thawing, plays the same part as the fire to an ice-plugged kitchen range or hot-water boiler without a sensitive or elastic safety-valve. The half worn out and never inspected until worn or burnt through boiler, in this case, is the weakest against expansion by heat, and so, of necessity, goes to the wall, and sometimes hurls persons into an early eternity. It would be well if we studied these questions and points more for mutual comfort and safety, if not for the profits of trade and the pleasureable interchange of thought in your pages.

Yours truly,

S. B. GOSLIN, F.M.S., &c.

Crescent Foundry, Cripplegate, E.C.,  
February 17th.



Prevention better than Damage, Suffering, or Loss of Life.

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## TEN BOILER EXPLOSIONS RECORDED IN TWO DAYS BY FROST.

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### RANDALL'S PATENT SAFETY-VALVES AND BOILER COCKS

Are designed to Prevent Boiler Explosions, and to  
Save Life and Limb.

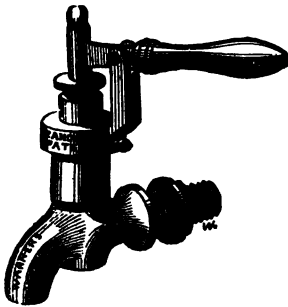
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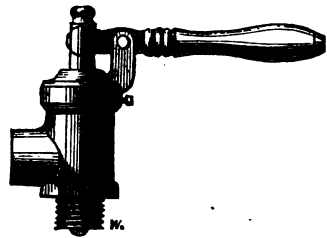
An unfailing Preventive of Kitchen Boiler Explosions.



No 381.



No. 517.



No. 382.

The fatal accident which occurred at Mr. W. Randall's, C.E., of Belsize Park, Hampstead, through the circulation pipes connected with the close boiler of the kitchen range having become frozen up, caused that gentleman to turn his attention to an improved safety-valve tap, the merits and application of which will be at once apparent by the following:—

The No. 381 tap should be fixed to the boiler itself, or to a pipe in connection with and as near to it as may be convenient, as a *hot water draw-off cock for domestic purposes*. The valve would thus be opened many times daily, and therefore could not stick fast, as other safety-valves often do, through being rarely brought into use. This tendency to stick, or "set"—which is the great defect of the ordinary "ground-in" safety-valve—is additionally guarded against in the Patent Tap by the face of the valve being of vulcanite, which cannot corrode, and will stand the action of hot water and steam for years without deterioration.

The spiral brass spring (which cannot waste by rust or heat), when screwed down to the utmost, balances the pressure exerted on the boiler by the water in the circulating pipes in houses 60 to 70 feet high. For less heights, the workman in fixing the tap has merely to unscrew the cap until the water issues from the side aperture, and to screw it down again until it ceases to run (but not further), and then to tighten up the small set screw.

When the circulating pipes become stopped by frost or any other cause, and the water and steam in the boiler attain a pressure greater than the weight of the water in the circulating pipes, the valve opens and the heated water escapes into the sink, or other receptacle placed beneath it; the draw-off tap thus forming, at the same time, a complete self-acting safety-valve.

*The No. 382 Valve is intended to be placed near the boiler and to be used as a test as well as a safety-valve—the handle being pressed down when the fire is lighted will show if steam is being generated instead of the boiler being fully charged with water.*

The No. 517 Valve is intended for Safety Boilers and Circulating Cisterns.

No. 381.—Randall's Patent Safety Draw-off Boiler Valve.	No. 517.—Safety-Valve for Boilers and Circulating Cisterns.	No. 382.—Randall's Patent Boiler Valve, Screwed for Iron Pipes, with Handle Testing Action.
$\frac{3}{4}$ in. ... .. 18/-	$\frac{3}{4}$ in. ... .. 8/-	$\frac{3}{4}$ in. ... 16/-
1 in. ... .. 22/-	1 in. ... .. 9 6	1 in. ... 20/-

*For description of application see page 10 and preceding woodcuts.*

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*See Society of Arts Congress Report for 1879.*

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